REMARKS

Applicant respectfully thanks the Office for the indication that claims 6 and 17 are merely objected to as depending upon a rejected base claim, but would be allowable if amended to incorporate the limitations of any base and intervening claims.

The remaining claims, i.e., claims 1, 3-5, 7-15, and 18-36, stand rejected based on prior art grounds.

Applicant respectfully requests favorable reconsideration of the application in view of the following remarks responsive to the Office Action of March 23, 2004.

The Present Invention

The present invention relates to microstrip antennas with improved low angle performance while not diminishing performance closer to the zenith. Particularly, the present invention improves low angle gain of a microstrip antenna primarily by two features of the design. The first feature is a dielectric lens that entirely encapsulates a patch and refracts electromagnetic waves so as to increase the gain at low angles while not substantially affecting gain at higher angles. The second feature is placing the patch on a second ground plane raised above a first ground plane. The raised, second ground plane further enhances the refraction effect, thereby increasing radiation gain at low angles without diminishing gain at the zenith.

The Prior Art Rejections

The Office rejected claims 1, 3-5, 7, 8, 14, 15, 18 and 23-36 under 35 U.S.C. § 103(a) as obvious over Openlander in view of Murphy. The Office further rejected claims 9-13 and 19-22 under 35 U.S.C. § 103(a) as obvious over Openlander in view of Murphy and further in view of Nichols.

The Office set forth a detailed explanation of these rejections in connection with at least the independent claims which will not be repeated herein. However, in short, the Office is relying on Openlander as teaching use of a lens to increase low angle gain and is relying on Murphy as teaching placing the first ground plane above and spaced apart from a second ground plane. Presumably, the Office also is of the opinion that it is obvious to combine the two references in a manner that results in

the present invention as claimed. However, the Office has made no such assertion nor provided any basis for reaching such a conclusion.

Applicant respectfully traverses.

As set forth in MPEP § 2143, a prima facie obviousness rejection must establish three things.

> First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art to modify the reference or to combine the reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations.

The Office has failed to present a prima facie obviousness case because it has not offered any basis for concluding that there is a "suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art to modify the reference or to combine the reference teachings" or "a reasonable expectation of success". In fact, the Office has not even asserted that a combination of Openlander and Murphy is obvious in the prior art or what that combination might be. A review of the Office Action shows that the Office has merely catalogued the alleged teachings of the two references with no assertion, let alone an explanation, that it is obvious to make a combination of the references. Accordingly, the rejection is prima facie improper and must be withdrawn.

In any event, there is no motivation in the prior art to combine the reference teachings. The relevant portion of Openlander is found in column 5, line 55 through column 6, line 5, where it discloses:

> As shown in FIG. 4, a plastic package with thick side walls covers and protects the antenna 58. The plastic package, particularly the top cover thereof, 62 may be made of dielectric or the like and has or incorporates prisms 64 at the edges in order to redirect the radiation pattern. In one such embodiment, prisms included in the decorative cover lowered the radiation angle of the PIFA antenna 58 shown in FIGS. 3 and 4 from forty degrees (40º) to twenty degrees (20º) without increasing the height of the overall antenna 58 with its package 60. As disk, or patch, antenna generally have a high radiation angle of sixty degrees (60º) to ninety degrees (90º), the prisms 64 serve to provide a radiation angle in the antenna 58 in a range of approximately seventy degrees (70º) to twenty degrees (20º) from the horizon. A foam layer having adhesive on both sides 66 may serve as a

cushion or contact in conjunction with the plastic base 40. The foam layer 66 may serve to seal the antenna 58 within the plastic package 60.

Turning to Murphy, it teaches, in connection with figure 6, for example, achieving "low angle, highly efficient radiation independent of the radiating aperture size by mounting the usual microstrip radiator structures on a pedestal formed in the ground plane surface, thereby creating an image radiator which can be used to modify the shape of the radiated beam from either a single radiator or from a phased array of such radiators disposed over a common ground plane surface". Column 2, lines 4-12. Murphy teaches a microstrip antenna having a first ground plane disposed above and apart from a second ground plane. However, the reason for doing so in Murphy is totally different than the reason for doing so in the present invention and is irrelevant to the prisms 64 in Openlander. Therefore, there is no motivation in the prior art to make the proposed combination.

More particularly, the purpose of providing the two, spaced-apart ground planes in Murphy is explained in column 3, line 24 through column 4, line 34 of Murphy. Particularly, Maxwell's equations dictate that the total portion of radiated energy at relatively low radiation angles along the ground plane surface increases as the height of the radiating aperture above the ground plane surface increases. For instance, this is illustrated in Figures 1-5 of Murphy. Specifically, Figures 1, 2, and 3 show the different radiation patterns as a function of the height of the aperture (the small circle in those figures) above the ground plane. Figure 4 of Murphy shows the radiator and the virtual reflected image radiator relative to the ground plane. Figure 5 shows the different radiation patterns expected for the three different positions of the radiating aperture shown in Figures 1, 2 and 3. Thus, Murphy is attempting to change the radiation pattern directly out of the radiating aperture of the microstrip by changing the vertical distance between the radiating aperture and the reflected image of the radiating aperture relative to the ground plane. As indicated in Murphy, this is accomplished by distances of ¼ or ½ of a wavelength. These are huge distances relative to the distances at issue in the present invention.

In the present invention, on the other hand, the microstrip and first ground plane are raised above the second ground plane in order to make it possible to practically form a lens that will have the correct optical properties close to the

radiating microstrip. More particularly, if the radiating microstrip is positioned directly on a large ground plane that extends transversely far beyond the microstrip, it would be very difficult to manufacture a lens with appropriate optical properties so close to the large ground plane. However, by placing the microstrip on a ground plane with transverse dimensions that are only slightly larger than the microstrip and then supporting that assembly above the second, larger ground plane via slanted support portions which provide open space immediately transversely adjacent the microstrip, it is much easier to fabricate the lens. See, for instance, page 5, line 18 through page 6, line 6 of the present specification.

Thus, there would be no motivation to make the proposed combination. Particularly, the theory of Murphy is that the radiator itself will radiate at low angles, in which case, the prism of Openlander may very well have an undesirable effect, rather than a desirable effect. Particularly, since the radiator of Murphy will already be producing significant radiation at low angles, the prisms 64 of Openlander will change that desired radiation pattern. It is difficult to know how it would change the radiation pattern, but it quite possibly will make it too narrow or possibly reverse the low angle pattern achieved by Murphy. Thus, at best, the results of the proposed combination are unpredictable (in which case, their would be no "reasonable expectation of success") and, at worst, the proposed combination has a deleterious effect opposite to the desired effect.

Furthermore, as noted above, the distances between the first and second ground planes suggested by Murphy (1/4 wavelength and ½ wavelength) are huge distances that would cause the antenna to have a very large profile, which is exactly the opposite of what Applicant is attempting to achieve, i.e., an antenna with a very low-profile, yet having good low angle gain.

In fact, this is why the slanted side portions recited in claims 6 and 17, which are the only two claims that the Office has indicated as allowable, are significant.

Hence, for the foregoing reasons it is not obvious to make any combination of Openlander and Murphy that results in the present invention and the independent claims 1 and 15 patentably distinguish over the prior art. Since all other claims depend from one of these claims, they too are patentable.

Even further, the dependent claims add even further patentably distinguishing recitations.

For instance, claims 26-28, and 31-33 recite specific values for radiation gain at specific angles relative to the same antenna without a lens. The Office has rejected these claims in view of the combination of Openlander with Murphy asserting that, even though the references do not disclose these particular gains, specific magnitudes of gains at a particular angle are limitations strictly dependent upon the material and thickness of the lens.

Applicant respectfully traverses. The Office appears to be asserting that, given the basic invention, achieving any particular gain at any particular angle is a matter of design specification. The Office is misinterpreting the import of these claim recitations. The import of these claim recitations is not merely the ability to achieve these gains at these specific angles, if desired. Rather, it is the discovery that they are particularly desirable specifications.

For instance, in connection with digital satellite radio in North America, such as that provided under the trade names XM™ and Sirius™, satellites are positioned at a fairly low angle to the horizon in order to cover a large geographic area with a small number of satellites (about 2 to 4). At least one of these satellite radio systems also uses a satellite close to the zenith. Accordingly, it is important to have excellent low angle gain while not substantially diminishing gain at zenith. This is achieved by the present invention, as described in the specification. Accordingly, antennas designed in accordance with the present invention that meet the limitations set forth in claims 26, 27, 28, 31, 32, and 33 work particularly well for these satellite radio applications.

Hence, claims 26-28 and 31-33 further patentably distinguish over the prior art of record.

Conclusion

In view of the foregoing amendments and remarks, this application is now in condition for allowance. Applicant respectfully requests the Examiner to issue a

Notice of Allowance at the earliest possible date. The Examiner is invited to contact Applicant's undersigned counsel by telephone call in order to further the prosecution of this case in any way.

Respectfully submitted,

Dated: 6.23.04

Theodore Naccarella
Registration No. 33,023
Synnestvedt & Lechner LLP
2600 Aramark Tower
1101 Market Street
Philadelphia, PA 19107
Telephone: (215) 923-4466
Facsimile: (215) 923-2189

M:\TNACCARELLA\CLIENTS\MA-COM\24992A\PTO\REPLY TO 3.24.04 OX.DOC